Department of Pesticide Regulation

Mary-Ann Warmerdam
Director

Arnold Schwarzenegger
Governor

September 15, 2008

Ms. Angela Somma
Chief
Endangered Species Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway
13th Floor
Silver Spring, MD 20910

Dear Ms. Somma:

The California Department of Pesticide Regulation (DPR) provides the following comments on the Draft Biological Opinion for Chlorpyrifos, Diazinon and Malathion as issued by the National Marine Fisheries Service (NMFS) on July 31, 2008.

1) DPR disagrees with NMFS' finding that U.S. EPA's proposed authorization for the registration of pesticide products containing the active ingredients chlorpyrifos, diazinon and malathion is likely to jeopardize the continued existence of the 10 Salmonid Evolutionarily Significant Units (ESUs) occurring in California. DPR also disagrees with NMFS' conclusion that U.S. EPA's proposed authorization for the registration of pesticide products containing the active ingredients chlorpyrifos, diazinon and malathion is likely to destroy or adversely modify designated critical habitat for the above mentioned salmonid ESUs.

2) A number of environmental factors believed to negatively impact salmonids are listed in the Biological Opinion. These include water flow, water temperature, removal of riparian habitat, urbanization, bank erosion, decreased base flow, sediment loadings, chemical pollutants from automobile traffic, wastewater treatment plants outflows, water chemistry, biota, canalization, heavy metals such as zinc, copper, lead, arsenic, mercury, infectious diseases, parasites, fertilizers, manures (nitrates), VOCs, nutrients, pathogenic bacteria, old organochlorines, reduced dissolved O2, and pesticides. Considering that the affected populations range from Southern California to the Canadian border (and beyond), these various factors should be accounted for in some manner. It is likely that in some habitats, pesticides are not a significant factor while urbanization, high water temperature or sediment loading is. It is not clear from reading the Biological Opinion that pesticides are a factor in any of the habitats.

3) The Biological Opinion appears to treat the various species, subspecies, and populations (ESUs) as a single unit with regard to the perceived effects of the three pesticides. No effort to differentiate subpopulations or varying exposure scenarios was made. This is an error since pesticide use and the resulting exposure, and the listed environmental factors, vary considerably over the vast range covered by the Biological Opinion.

4) In reported sampling and monitoring results, some of the monitoring is admittedly biased. For example, in a section titled Monitoring: Measured Concentrations of Chlorpyrifos, Diazinon, and Malathion (page 224, 1st paragraph), it states, "The NAWQA design does not result in unbiased representation of surface water." We interpret this to mean that the NAWQA design results in a biased representation of surface waters. The concentrations (NAWQA: Table 37, page 224) range from 0.13 - 0.4 ppb for chlorpyrifos. In EPA biological opinions (Table 38, page 224), maximum concentrations of 0.35 - 2.28 ppb were reported. In a summary of USGS NAWQA program results (Table 39, page 225) chlorpyrifos levels ranged from 0.004 - 0.401 ppb with an arithmetic mean of 0.022 ppb. This range represented over a thousand samples from various watersheds. The report tables commonly list maximum concentrations observed. The utility of one sample value is questionable, but the utility of the sample value is meaningless without location data tying the sample to a stream or river containing salmonids. Further, it is not clear if the sampled watersheds represented actual fish habitat, agricultural drainages, or field drains. Additionally, the highest level of chlorpyrifos found in this series of samples means little if it is not correlated with actual fish habitat. Minimal attempt to correlate pesticide concentrations with particular water bodies is made, although clearly these data are available. Pesticide concentrations are not provided for most river systems. Pesticide concentrations drop drastically in relation to the distance from agricultural drainages.

5) The Biological opinion states that there are factors that limit the utility of monitoring as a descriptor of concentrations for assessing the effects. The factors include, the monitoring data:

a) "were not designed to capture peak concentrations or durations of exposure."
This is not true. NAWQA attempted to sample during runoff events to get peak concentrations.

b) "have not been put into perspective with regard to use of pesticides."
DPR sampling is correlated with pesticide use. In California, the monitoring by DPR and USGS has been done based on pesticide use. DPR has the most comprehensive pesticide use reporting in the US. All pesticide use in agriculture is reported by location, commodity, and date, in addition to many other reporting requirements. Several agencies use these data to pinpoint sampling site locations to ensure water monitoring will result in a worst case scenario with respect to water concentrations. NMFS has ignored this selective, comprehensive sampling that has been ongoing in California nearly 20 years. If there are 1,000 + samples from various waterways, it is not clear what perspective is missing. NMFS then reports levels from runoff over sod, bare ground and other surfaces. No salmonids are found in this habitat but the values are alarming. However, when sampling in rivers and streams that may contain salmonids, the biological opinion chooses to minimize these results. Actually, the opposite argument can be made. The Biological Opinion has not put pesticide concentrations into perspective with regard to fish habitat.

c) "may not be representative of current and future uses and conditions."
The report uses this argument to justify the use of models. The resulting values from the model are, of course, much higher than values measured in California. Another critical point to note is that the Biological Opinion is based on data and pesticide labels that date from before 2002. Chlorpyrifos and diazinon labels have changed significantly since that time. Changes include fewer use sites, lower application rates, and buffer zones, among

others. Furthermore, DPR has conducted several studies since 2002 that reflect current water concentrations after the advent of new use restrictions on diazinon and chloropyrifos (See Appendix 3). These new data should be considered in this opinion.

6) The effects section of the report lists LC_{50} values of chlorpyrifos to salmonids ranging from 0.8 - 2200 ppb. DPR has 10 ppb on file for Rainbow trout. The report stresses two studies performed by one lab in 1983 (Jarvinen et al., 1983). The studies were life-cycle study on fathead minnows, one with technical grade chlorpyrifos and one with a formulated product, Dursban CR. The study found chronic and sublethal effects as low as 0.12 ppb to fathead minnows from chlorpyrifos exposure. More recent studies found effects at 3.2 and 4.8 ppb to fathead minnows (reduced growth). An area of concern is the effects to invertebrates on which juvenile salmonids might feed. The Biological Opinion reports LC_{50} values for chloropyrifos in the 0.005 - 0.8 ppb range to various invertebrates. Other effects levels mentioned in the report were much higher (some over 10 ppb). The above examples illustrate a major shortcoming of this Biological Opinion: it must be based on the best available data and it isn't. If the LC_{50} of chlorpyrifos to the salmonids was 2200 ppb, chlorpyrifos would be considered "moderately toxic" according to U.S. EPA guidelines and likely of little interest with regard to salmonid population health, while at 0.8 ppb, it is extremely toxic. The Jarvinen study was conducted more than 25 years ago on a different species. Study standards and protocols have changed significantly since that time. According to DPR files and based on GLP standards, the LC_{50} values of the three pesticides to a salmonid and an aquatic invertebrate are as follows:

	Rainbow trout	Daphnia magna
Chlorpyrifos	10 ppb	450 ppb
Diazionon	800 ppb	5.03 ppb
Malathion	170 ppb	1.8 ppb

Additionally, DPR has a formal Reevaluation Program. California regulations require DPR to investigate all reports of actual or potentially significant adverse effects to people or the environment resulting from the use of pesticides. If DPR has reason to believe that a pesticide may cause unreasonable adverse effects to people or the environment, the regulations require DPR to reevaluate the pesticide to determine if it should remain registered. DPR has placed chlorpyrifos and diazinon into reevaluation to reduce levels in surface waters in California (see Appendix 1). Furthermore, the California State Water Resources Control Board and the nine Regional Water Quality Control Boards (Regional Boards) already have in place programs that protect salmonids and other aquatic life from potentially adverse effects from diazinon, chlorpyrifos, malathion, and other pesticides (see Appendix 2). No mention of these efforts or many other efforts at the local level to reduce the concentrations of the various pesticides in water is made in the Biological Opinion. According to the reports in the DPR Reevaluation, exceedances are still occurring but the target concentrations based on Department of Fish and Game (DFG) Water Quality Criteria (WQC) of 0.02 *u*g/L (acute toxicity, one hour average) and 0.014 *u*g/l (chronic toxicity, four-day average) are at or below the reported effects levels to salmonids, but above the effects levels reported for some invertebrates (salmonids prey).

The Biological Opinion has no target concentrations. With ever decreasing detection levels, there must be some level below which the impact to salmonids would be negligible, but none are provided.

7) The Biological Opinion summarizes the monitoring data before dismissing it as being not particularly useful. The use of the monitoring data can only be applied in a general sense when simply viewed without regard to the spatial variability in concentrations. Where location-specific values are reported, they are not characterized with regard to fish habitat. The report uses modeling that provides information on field runoff (immediately adjacent to the treated field) to justify the conclusions rather than available monitoring data from streams and rivers inhabited by the various salmonids. However, given the large volume of data that exists throughout California from the USGS, DPR, CDFG, and State and Regional Water Board programs, it is unclear why NMFS chose to use modeled data for California instead. Appendix 3 in this document provides several sources of information for NMFS to consider for inclusion in their analysis.

8) The report lists many factors for the declines in salmonids. They make no effort to weight these various factors. While the argument for jeopardy to the various salmonids from pesticides is relatively weak, there are specific cases reported where low or no water prevented salmonids from reaching spawning habitat. Claiming that the three pesticides uniformly impact each salmonid population in every river and stream from Central California to the Washington – Canada border is not supported. As detailed above, they overstate and over-generalize the pesticide concentrations they feel should be used to make their decision. They minimize the usefulness of actual monitoring results. In Appendix 3 of these comments, we have included a listing of publications by DPR and USGS containing malathion, chlorpyrifos and diazinon detections in surface water and sediment from 1990 to 2008.

Considering the potential impact of this opinion, the authors should have evaluated each biological unit and each river or stream containing biological units. The report should have listed monitoring results, by river or stream, and some attempt to weight the other factors should be made. It does no good to prevent chlorpyrifos use in an area where sampling has shown no or minimal chlorpyrifos levels, where there are no fish, or where other factors are responsible for salmonid reductions.

Finally, DPR's Endangered Species Program -in place since 1988- provides pesticide use restrictions that have been vetted through the U.S. EPA, the U.S. Fish and Wildlife Service, National Marine Fisheries Service, California Department of Fish and Game, California Department of Food and Agriculture, our local county agricultural commissioners, and other stakeholders under Section 7 (a) (1) of the Endangered Species Act to protect salmonids in California (Chinook Salmon, Coho Salmon, and Steelhead) and their habitat, even during consultations and determinations under Section 7 (a) (2). DPR's program provides straight-forward pesticide use restrictions for specified geographic areas that protect all salmonid ESUs. Since April of 2005, said restrictions are accessed by pesticide applicators, regulators and others through our existing on-line database called "PRESCRIBE". This database ensures easy access to the information applicators need for proper implementation of the Endangered Species Act,

and the preventive protection of salmonids and other listed, proposed and rare species, all within one Web site. (See www.cdpr.ca.gov/docs/es/prescint.htm)

Sincerely,

Original Signed by
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APPENDIX 1

DPR's reevaluation of chlorpyrifos and diazinon

DPR is currently reevaluating pesticide products containing diazinon and chlorpyrifos based on finds in certain California waters of exceedances of the Department of Fish and Game's (DFG's) water quality criteria (WQC) for the protection of aquatic life. DFG's WQC for diazinon is 0.08 µg/L (acute toxicity, one hour average) and 0.05 µg/L (chronic toxicity, four-day average). DFG's WQC for chlorpyrifos is 0.02 µg/L (acute toxicity, one hour average) and 0.014 µg/L (chronic toxicity, four-day average).

To mitigate off-site movement of diazinon residues, diazinon registrants developed supplemental labeling for dormant spray uses. The labeling adds mitigation measures, such as restricting application to ground equipment only, prohibiting application within 100 feet upslope of "sensitive aquatic sites," and prohibiting application to orchards when soil moisture is at field capacity, or when a storm event is likely. In addition, in July 2006, DPR adopted regulations, which place additional restrictions on the use of pesticides as dormant sprays (Title 3 of the California Code of Regulation, Subchapter 5, Surface Water, Article 1, Pesticide Contamination Prevention, Section 6960 entitled "Dormant Insecticide Contamination Prevention.")

Pursuant to the chlorpyrifos reevaluation, registrants are required to identify the processes by which chlorpyrifos pesticides products are contributing to detections of chlorpyrifos in surface water at levels that exceed WQC and mitigation strategies that have been shown to reduce or eliminate chlorpyrifos residues in surface water. In addition, in June 2000, in a Memorandum of Agreement with the U.S. Environmental Protection Agency
(U.S. EPA), chlorpyrifos registrants agreed to eliminate residential uses, phase out termite applications, and significantly reduce chlorpyrifos application rates on golf courses. In 2002, as a result of the U.S. EPA's Interim Reregistration Eligiblity Decision (IRED), chlorpyrifos registrants placed additional mitigation measures on the labels of their products. The mitigation measures included the use of buffer zones to protect water quality and fish and wildlife, and reductions in application rates, the number of applications per season, seasonal maximum amounts applied, and increases in the minimum intervals for retreatment. DPR is currently requiring chlorpyrifos registrant to conduct monitoring in California to demonstrate effectiveness of the mitigation measures. According to data on file with DPR, exceedances of the WQC are still occurring. The concentrations found are at or below the reported effects levels to salmonids, but above the effects levels reported for invertebrates (salmonids prey).

The Biological Opinion makes no mention of DPR's efforts or efforts at the local level to reduce the concentrations of chlorpyrifos and diazinon in California waters.

APPENDIX 2

Activities of the State Water Resources Control Board and the Regional Water Quality Control Boards Related to Managing Diazinon, Chlorpyrifos, and Malathion in Salmonid Habitats

State Water Resources Control Board and the nine Regional Water Quality Control Boards (Regional Boards) already have in place programs that protect salmonids and other aquatic life from potentially adverse effects from diazinon, chlorpyrifos, malathion, and other pesticides. Following responsibilities outlined in the federal Clean Water Act (CWA), these agencies develop plans, known as total maximum daily loads (TMDLs), for restoring water quality in water bodies where beneficial uses, such as aquatic habitat, are impaired by environmental stressors, including pesticides. California's most recent list of such water bodies, known as the 303(d) list (named after section 303[d] in the CWA), includes 71 water bodies where diazinon is a stressor, 25 where chlorpyrifos is, and 1 where malathion is. Diazinon and/or chlorpyrifos TMDLs have already been adopted for key water bodies that provide habitat for salmonids: the Sacramento, Feather, and San Joaquin rivers, the Sacramento-San Joaquin River Delta, and creeks in the San Francisco Bay Area. More information on California's TMDL program can be found at http://www.waterboards.ca.gov/water_issues/programs/tmdl/tmdl.shtml.

Regional Boards administer another water quality improvement program: the Irrigated Lands Regulatory Program (ILRP). This program is derived from California's Water Code and focuses water quality assessment and mitigation strategies on runoff from irrigated agriculture. It aims to assure compliance with all applicable water quality standards, including those that apply to pesticides and toxic effects they may cause. It also has an explicit regulatory structure that the TMDL program does not have. In fact, the ILRP, with its regulatory and enforcement provisions, is regarded as the key mechanism for implementing TMDLs in California. The Central Valley and Central Coast Regional Boards have the most fully developed ILRPs.

Information on the Central Valley Regional Board's ILRP can be found at http://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/. More specific information on ILRP-related monitoring can be found at http://www.waterboards.ca.gov/centralvalley/water_issues/irrigated_lands/monitoring/index.shtml.

Information on the Central Coast Regional Board's ILRP can be found at http://www.waterboards.ca.gov/centralcoast/AGWaivers/Index.htm. More specific information on ILRP-related monitoring can be found at http://www.ccamp.org/ and http://www.ccwqp.org/.

APPENDIX 3

DPR Publications containing Malathion, Chlorpyrifos, and Diazinon Detections in Surface Water and Sediment: 1990 – current

USGS Publications containing Malathion, Chlorpyrifos, and Diazinon Detections in surface Water and Sediment: 1990-2008

Journal References for Diazinon, Chlorpyrifos, and Malathion Detections In California's surface Water: 1990-2008

DPR Publications containing Malathion, Chlorpyrifos, and Diazinon Detections in Surface Water and Sediment: 1990- current

Posted at http://www.cdpr.ca.gov/docs/emon/surfwtr/swemreps.htm

EH 06-01	Bacey, J., F. Spurlock, 2007. **Identifying Correlations Between Macroinvertebrate Communities and Pesticides and Other Environmental Variables of Agricultural Runoff.**
EH 05-01	Bacey, J. 2005. **Biological Assessment of Urban and Agricultural Streams in the California Central Valley (Fall 2002 through Spring 2004).**
EH 04-01	Bacey, J., K. Starner, and F. Spurlock. 2004 **The Occurrence and Concentration of Esfenvalerate and Permethrin in Water and Sediment in the Sacramento and San Joaquin Watersheds.**
EH 03-04	L. Guo. 2003. **Semi-Empirical Prediction of Pesticide Loading in the Sacramento and San Joaquin Rivers During Winter Storm Seasons.**
EH 03-03	Starner, K. , F. Spurlock, S. Gill , K. Goh , H. Feng , J. Hsu, P. Lee , D. Tran , and J. White. 2003. **Monitoring Surface Waters of the San Joaquin River Basin for Selected Summer-Use Pesticides, 2002.**
EH 02-02	Spurlock, F., C. Garretson, G. Jorgenson, E. Norum, H. Gonsalves, H. Feng, J. Hernandez, and J. Hsu. 2002. **Runoff of Diazinon from Turf: Effect of Water Application, Slope, and Formulation.**
EH 01-01	Spurlock, F.2002. **Analysis of Diazinon and Chlorpyrifos Surface Water Monitoring and Acute Toxicity Bioassay Data, 1991- 2001.**
EH 00-09	Ross, L.J., R. Stein, J. Hsu, J. White, and K. Hefner. 2000. **Insecticide Concentrations in the San Joaquin River Watershed, California .**
EH 99-01	Ross, L. J., R. Stein, J. Hsu, J. White, and K. Hefner. 1999. **Distribution and Mass Loading of Insecticides in the San Joaquin River, California, Spring 1991 and 1992**.
EH 98-05	Singhasemanon, N., C. Nordmark, and T. Barry. 1998. **Diazinon and Chlorpyrifos in the Central Contra Costa Sanitary District Sewer System, Summer 1996.**
EH 98-03	Bennett, K. P., N. Singhasemannon, N. Miller, and R. Gallavan. 1998. **Rice pesticides in the Sacramento Valley, 1995.**
EH 98-02	Bennett, K. P., C. E. Nordmark, J. Schuette, H. Feng, J. Hernandez, and P. Lee. 1998. **Occurence of aquatic toxicity and dormant spray pesticide detections in the San Joaquin River Watershed, Winter 1996-97.**
EH 98-01	Nordmark, C. E., K. P. Bennett, H. Feng, J. Hernandez, and P. Lee. 1998. **Occurence of Aquatic Toxicity and Dormant-Spray Pesticide Detections in the Sacramento River Watershed, Winter 1996-97**.
EH 97-06	Ganapathy C., C. Nordmark, K. Bennett, and A. Bradley. 1997. **Temporal distribution of insecticide residues in four California rivers.**
EH 97-03	Ross, L. J., K. D. Bennett, K. D. Kim, K. Hefner, and J. Hernandez. 1997. **Reducing Dormant Spray Runoff from Orchards.**
EH 96-02	Ross, L.J., R. Stein, J. Hsu, J. White, and K. Hefner. 1996. **Distribution and Mass Loading of Insecticides in the San Joaquin River, California.**
EH 93-03	Neal, R.H., P.M. McCool, and T. Younglove. 1993. **Assesssment of Malathion and Malaoxon Concentration and Persistence in Water, Sand, Soil, and Plant Matrices Under Controlled Exposure Conditions.**
EH 93-01	Ando, C., J. Leyva, and C. Gana. 1993. **Monitoring Diazinon in the Mediterranean Fruit Fly Eradication Soil Treatment Program, Los Angeles County, California, 1992.**
EH 91-02	Turner, B., S. Powell, D. Gonzales, and C. Ando. 1991. **The Influence of Dormant Spray Oil on Diazinon Deposition and Transfer to Non-Target Vegetation.**

USGS Publications containing Malathion, Chlorpyrifos, and Diazinon Detections in Surface Water and Sediment: 1990- 2008

USGS Publication

http://pubs.er.usgs.gov/usgspubs/index.jsp?jboEventVo=PubResultView&view=basic&jboEvent=Search&pxfield_all=pesticides&test=++Go++

2006 DS 197
Seasonal changes in concentrations of dissolved pesticides and organic carbon in the Sacramento-San Joaquin delta, California, 1994-1996
Orlando, James L.; Kuivila, Kathryn M.

2005 DS 107
Data on dissolved pesticides and volatile organic compounds in surface and ground waters in the San Joaquin-Tulare basins, California, water years 1992-1995
Kinsey, Willie B.; Johnson, Mark V.; Gronberg, JoAnn M.

2005 SIR 2005-5220
Analysis of pesticides in surface water and sediment from Yolo Bypass, California, 2004-2005
Smalling, Kelly L.; Orlando, James L.; Kuivila, Kathryn M.

2005 SIR 2005-5203
Occurrence and distribution of pesticide compounds in surface water of the Santa Ana basin, California, 1998-2001
Kent, Robert; Belitz, Kenneth; Altmann, Andrea J.; Wright, Michael T.; Mendez, Gregory O.

2004 OFR 2004-1214
Dissolved Pesticide and Organic Carbon Concentrations Detected in Surface Waters, Northern Central Valley, California, 2001-2002
Orlando, James L.; Jacobson, Lisa A.; Kuivila, Kathryn M.

2004 DS 104
Pesticide concentrations in water and in suspended and bottom sediments in the New and Alamo rivers, Salton Sea Watershed, California, April 2003
LeBlanc, Lawrence A.; Orlando, James L.; Kuivila, Kathryn M.

2004 OFR 2004-1214
Dissolved Pesticide and Organic Carbon Concentrations Detected in Surface Waters, Northern Central Valley, California, 2001-2002
Orlando, James L.; Jacobson, Lisa A.; Kuivila, Kathryn M.

2004 SIR 2004-5117
Occurrence, distribution, and transport of pesticides, trace elements, and selected inorganic constituents into the Salton Sea Basin, California, 2001-2002
LeBlanc, Lawrence A.; Schroeder, Roy A.; Orlando, James L.; Kuivila, Kathyrn M.

2003 OFR 2003-101
Dissolved pesticide concentrations detected in storm-water runoff at selected sites in the San Joaquin River basin, California, 2000-2001
Orlando, James L.; Kuivila, Kathryn M.; Whitehead, Andrew

2003 WRI 2003-4088
Evaluation of Diazinon and Chlorpyrifos Concentrations and Loads, and other Pesticide Concentrations, at Selected Sites in the San Joaquin Valley, California, April to August, 2001
Domagalski, Joseph L.; Munday, Cathy

2002 OFR 2002-232
Dissolved pesticides in the Alamo River and the Salton Sea, California, 1996-97
Crepeau, Kathryn L.; Kuivila, Kathryn M.; Bergamaschi, Brian

2000 WRI 2000-4203
Pesticides in surface water measured at select sites in the Sacramento River basin, California, 1996-1998
Domagalski, Joseph L.

1998 WRI 98-4032
Occurrence and distribution of dissolved pesticides in the San Joaquin River basin, California
Panshin, Sandra Yvonne; Dubrovsky, Neil M.; Gronberg, JoAnn M.; Domagalski, Joseph L.

1997 WSP 2468
Pesticides in surface and ground water of the San Joaquin-Tulare Basin, California; analysis of available data, 1966 through 1992
Domagalski, Joseph L.

1997 FS 075-97
Pesticides in surface water, bottom sediment, crayfish, and shallow ground water in Las Vegas Valley area, Carson River Basin, and Truckee River Basin, Nevada and California, 1992-95
Kilroy, Kathryn C.; Watkins, Sharon A.

1997 OFR 97-24
Pesticides associated with suspended sediments in the San Francisco Bay Estuary, California
Bergamaschi, Brian A.; Crepeau, Kathryn L.; Kuivila, Kathryn M.

1997 WRI 97-4106
Water-quality assessment of the Las Vegas Valley area and the Carson and Truckee River basins, Nevada and California, nutrients, pesticides, and suspended sediment, October 1969-April 1990
Kilroy, K. C.; Lawrence, S. J.; Lico, M. S.; Bevans, H. E.; Watkins, S. A.

1995 FS 133-95
Inputs of the Dormant-Spray Pesticide, Diazinon, to the San Joaquin River, California, February 1993
Domagalski, Joseph L.; Dubrovsky, Neil M.; Kratzer, Charles R.

1995 OFR 95-165
Nonpoint sources of pesticides in the San Joaquin River, California; input from winter storms, 1992-93
Domagalski, Joseph L.

1995 OFR 95-110
Dissolved pesticide data for the San Joaquin River at Vernalis and the Sacramento River at Sacramento, California, 1991-94
MacCoy, Dorene E.; Crepeau, Kathryn L.; Kuivila, Kathryn M.

Journal References for Diazinon, Chlorpyrifos, and Malathion Detections in California's Surface Water: 1990-2008.

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